

INVESTIGATION OF COVID-19 EPIDEMIOLOGY USING ADOMIAN DECOMPOSITION METHOD UNDER ELZAKI TRANSFORM

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ABSTRACT

This study addresses the efficacy of social isolation during the lockdown period of COVID-19 epidemiology using the Adomian decomposition approach under the Elzaki transformation. This pandemic has been hazardous all across the world from late 2019 to 2021, and some instances are still ongoing. It also highlighted how social separation is correlated to a decrease in COVID-19 instances among Indian people. Furthermore, figures have also been provided to manifest the results of social isolation in the reduction of COVID-19 instances among individuals.

Keywords: COVID-19, Adomian Decomposition Method, Elzaki transform.

2020 Mathematics Subject Classification: 44A99; 44A15; 65D05.

1. INTRODUCTION

Integral transformations are critical in studying COVID-19 dynamics. The Laplace transform, which is used to solve differential equations driving disease propagation, helps predict infection rates and evaluate intervention success. Furthermore, the Fourier transform is commonly used in medical imaging techniques such as CT scans and MRI to diagnose and monitor COVID-19 patients [1]. Integral transformations reveal latent patterns in epidemiological data, leading to targeted treatments and resource allocation techniques. Overall, integral transforms provide essential insights into transmission patterns and enable successful pandemic-related public health interventions.

COVID-19, which is caused by SARS-CoV-2, has had a global health and economic effect. Extensive research, immunization programs, and social interventions are among the efforts made. Emerging mutations and vaccination dissemination are among the challenges. Continuous monitoring and worldwide collaboration are critical [2]-[4].

The Elzaki transformation provides a unique technique for understanding COVID-19 dynamics, assisting in the resolution of differential equations regulating disease transmission. Researchers may use this transformation to provide analytical solutions that help with forecasting and decision-making in public health initiatives. The Elzaki transformation is a viable method for recognizing and minimizing the effects of COVID-19.

The Elzaki transformation and Adomian composition approach are useful mathematical tools for examining the dynamics of the COVID-19 epidemic. These approaches allow for the solution of complicated differential equations regulating disease transmission and intervention tactics, offering insights into infection rates, recovery rates, and other epidemiological characteristics [5]. Researchers may use these mathematical tools to provide analytical answers that help with forecasting, decision-making, and the creation of effective mitigation measures in public health initiatives.

2. MATERIALS AND METHODS

2.1. Elzaki Transform

The Elzaki transform is represented by the operator $\dot{E}(\cdot)$ and specified by integral equations [6]

$$\dot{E}[f(t)] = T(v) = v \int_0^{\infty} f(t) e^{-\frac{t}{v}} dt, t \geq 0, k_1 \leq v \leq k_2$$

The inverse of the Elzaki transform is given by

$$\dot{E}^{-1}[\mathcal{F}(v)](t) = \frac{1}{2\pi j} \int_{a-j\infty}^{a+j\infty} \mathcal{F}\left(\frac{1}{v}\right) e^{tv} v dv$$

There is a list of some functions with their Elzaki transform given below [6],[7],[8],[9]:

S. No.	Functions $f(t)$	Elzaki transform
1.	1	v^2
2.	t	v^3
3.	e^{at}	$\frac{v^2}{1-av}$
4.	$t^n, n \geq 0$	$n! v^{n+2}$
5.	$\sin at$	$\frac{av^3}{1+av^2}$
6.	$\cos at$	$\frac{v^2}{1+a^2v^2}$
7.	$\sinh at$	$\frac{av^3}{1-a^2v^2}$
8.	$\cosh at$	$\frac{av^2}{1-a^2v^2}$
9.	$e^{at} \sin bt$	$\frac{bv^3}{(1-av)^2 + b^2v^2}$
10.	$e^{at} \cos bt$	$\frac{(1-av)v^2}{(1-av)^2 + b^2v^2}$
11.	$t \sin at$	$\frac{2av^4}{1+a^2v^2}$
12.	$t \cos at$	$\frac{v^3}{1+a^2v^2}$

13.	$t e^{at}$	$\frac{v^3}{1-av}$
14.	e^{at}	$\frac{v^2}{1-av}$
15.	Convolution theorem $[\dot{E}(f * g)]$	$\frac{1}{v} \dot{E}(f) \dot{E}(g)$

2.2. The initial method for formulating the input equation

A few recent independent studies on the coronavirus disease (COVID-19) by Chen [10] and Zhang [11] successfully applied mathematical models. The mathematical equation by Khan and colleagues has been utilized and modified in this context [12], presented as:

$$\begin{aligned} \mathcal{D}_t J(t) &= c - \Lambda J - \frac{\delta J(\mathcal{U} + B\mathcal{G})}{\mathcal{N}} - \Upsilon J\mathcal{W} \\ \mathcal{D}_t \mathcal{H}(t) &= \frac{\delta J(\mathcal{U} + B\mathcal{G})}{\mathcal{N}} + \Upsilon J\mathcal{W} - (1 - \Omega)\varphi \mathcal{H} - \Omega\varpi \mathcal{H} - \Lambda \mathcal{H} \\ \mathcal{D}_t \mathcal{U}(t) &= (1 - \Omega)\varphi \mathcal{H} - (\varrho + \Lambda)\mathcal{U} \\ \mathcal{D}_t \mathcal{G}(t) &= \Omega\varpi \mathcal{H} - (\varsigma + \Lambda)\mathcal{G} \\ \mathcal{D}_t \mathcal{C}(t) &= \varrho \mathcal{U} + \varsigma \mathcal{G} - \Lambda \mathcal{C} \\ \mathcal{D}_t \mathcal{W}(t) &= \mathfrak{Y}\mathcal{U} + \mathfrak{X}\mathcal{G} - \xi \mathcal{W} \end{aligned} \tag{1}$$

under the initial conditions:

$$J(0) = J_0; \mathcal{H}(0) = \mathcal{H}_0; \mathcal{U}(0) = \mathcal{U}_0; \mathcal{G}(0) = \mathcal{G}_0; \mathcal{C}(0) = \mathcal{C}_0; \mathcal{W}(0) = \mathcal{W}_0$$

In this equation, $\mathcal{N}$ represents the entire population, which is divided into five sub-classes: infection-prone individuals $J(t)$, vulnerable individuals $\mathcal{H}(t)$, diseased individuals $\mathcal{U}(t)$, progressively infected individuals $\mathcal{G}(t)$, emancipated individuals $\mathcal{C}(t)$ and reservoirs $\mathcal{W}(t)$ (sources of virus-like seafood). Table 1 defines the necessary parameters for this equation.

The description of parameters relevant to the equation, its notation, and value [13].

Table 1

Description of parameter	Notation	Value	References
Birth rate	c	6,931,614.27	Estimated
Contact rate	δ	0.25	Estimated [15]
Natural mortality rate	Λ	0.014	Fitted [14]
Transmission rate	B	0.5944	Fitted [15]
Pace of growth	φ	0.004787	Fitted [15]

Incubation time	ϖ	0.05	Fitted [16]
The proportion of asymptotic infection	Ω	0.01243	Fitted
Disease transmission coefficient	$\check{Y}$	0.123×10^{-7}	Fitted
Recovery of elimination of the rate of U	ϱ	0.09871	Fitted [17]
Recovery of elimination of the rate of G	ς	0.8543	Fitted [17]
Contribution of the virus to W via U	κ	0.000398	Fitted [17]
Contribution of the virus to W via G	γ	0.001	Fitted
Removing the rate of virus from W	ξ	0.01	Fitted

3. THEORY AND NUMERICAL SCHEMES

3.1. Adomian Decomposition Method (ADM)

It was developed by George Adomian, who chaired the Center for Applied Mathematics at the University of Georgia during the 1970s to 1990s.

We employ ADM, a semi-analytic approach, to solve ordinary and partial non-linear differential equations.

When a nonlinear section is decomposed, we get a sequence of Adomian polynomials. Using the Adomian polynomial [18] and a recursive relationship, a series-based solution is achieved. The technique is computed using

At first, we are taking the non-linear equation:

$$\mathcal{B} = \mathcal{b}$$

where, $\mathcal{B}$ is a non-linear operator and $\mathcal{b}$ maybe both function and value.

Then, the equation $\mathcal{P}y(\mathfrak{t}) + \mathcal{Q}y(\mathfrak{t}) + \mathcal{R}y(\mathfrak{t}) = \mathcal{b}(\mathfrak{t})$ is the operator form of the equation.

Now, taking $\mathcal{P}^{-1}$ on each side,

$$\begin{aligned} &\mathcal{P}^{-1}\mathcal{P}y(\mathfrak{t}) + \mathcal{P}^{-1}\mathcal{Q}y(\mathfrak{t}) + \mathcal{P}^{-1}\mathcal{R}y(\mathfrak{t}) = \mathcal{b} \\ \Rightarrow &y(\mathfrak{t}) = \mathcal{b}(\mathfrak{t}) - \mathcal{P}^{-1}\mathcal{Q}y(\mathfrak{t}) - \mathcal{P}^{-1}\mathcal{R}y(\mathfrak{t}) \end{aligned}$$

Considering the unknown function $y(\mathfrak{t})$ may be expressed as the summation of an infinite series $y_0 + y_1 + y_2 + y_4 + \dots$ and so on. i.e., $y(\mathfrak{t}) = \sum_{n=0}^{\infty} y_n$

Let $y_0 = \mathcal{b}(\mathfrak{t})$

Using recursive relationships to acquire more terms of the series. Here $\mathcal{R}y(\mathfrak{t})$ can be written as:

$$\mathcal{R}y(\mathfrak{t}) = \sum_{n=0}^{\infty} \mathcal{T}_n$$

To determine the value of $\mathcal{T}_n$, we need a grouping parameter $\mathfrak{c}$. Therefore, we have

$$\mathcal{T}_n = \frac{1}{n!} \frac{d^n}{d\mathfrak{c}^n} \mathcal{R}y(\mathfrak{c}) \text{ and } \mathfrak{c} = 0$$

As a result, ADM yields a convergent series solution [19]-[20]. This solution achieves absolute and uniform convergence.

3.2. Investigation with ADM

The Adomian Decomposition approach (ADM) is a semi-analytical approach for solving ordinary and partial nonlinear differential equations. George Adomian created the approach from 1970s to 1990s. The Adomian decomposition technique (ADM) [21] can be significantly used for solving linear, nonlinear, ordinary, and partial equations. The approach for solving differential equations and integral transforms, including Volterra and Fredholm integral transforms, has been updated in recent works [22]. We utilized Eq. (1) to simulate, fit data, and estimate values using ADM. We used the $\dot{E}$ operator for the first-order differential equation and expressed equation (1) as

$$\begin{aligned}\dot{E}J(\mathfrak{t}) &= \mathfrak{c} - \Lambda J - \frac{\mathfrak{d}J(\mathcal{U} + \mathfrak{B}\mathcal{G})}{\mathcal{N}} - \ddot{Y}J\mathcal{W} \\ \dot{E}\mathcal{H}(\mathfrak{t}) &= \mathfrak{d}J(\mathcal{U} + \mathfrak{B}\mathcal{G}) + \ddot{Y}J\mathcal{W} - (1 - \Omega)\varphi\mathcal{H} - \Omega\varpi\mathcal{H} - \Lambda\mathcal{H} \\ \dot{E}\mathcal{U}(\mathfrak{t}) &= (1 - \Omega)\varphi\mathcal{H} - (\varrho + \Lambda)\mathcal{U} \\ \dot{E}\mathcal{G}(\mathfrak{t}) &= \Omega\varpi\mathcal{H} - (\varsigma + \Lambda)\mathcal{G} \\ \dot{E}\mathcal{C}(\mathfrak{t}) &= \varrho\mathcal{U} + \varsigma\mathcal{G} - \Lambda\mathcal{C} \\ \dot{E}\mathcal{W}(\mathfrak{t}) &= \mathfrak{k}\mathcal{U} + \mathfrak{y}\mathcal{G} - \xi\mathcal{W}\end{aligned}\quad (2)$$

Applying $\dot{E}^{-1}$ operator on both sides, we get

$$\begin{aligned}J(\mathfrak{t}) &= J_0 + \mathfrak{c} - \Lambda\dot{E}^{-1}J(\mathfrak{t}) - \dot{E}^{-1}\left[\frac{\mathfrak{d}}{\mathcal{N}}(J\mathcal{U} + \mathfrak{B}J\mathcal{G}) + \ddot{Y}J\mathcal{W}\right] \\ \mathcal{H}(\mathfrak{t}) &= \mathcal{H}_0 + \dot{E}^{-1}\left[\frac{\mathfrak{d}(J\mathcal{U} + \mathfrak{B}J\mathcal{G})}{\mathcal{N}} + \ddot{Y}J\mathcal{W}\right] - [(1 - \Omega)\varphi + \Omega\varpi + \Lambda]\dot{E}^{-1}\mathcal{H}(\mathfrak{t}) \\ \mathcal{U}(\mathfrak{t}) &= \mathcal{U}_0 + (1 - \Omega)\varphi\dot{E}^{-1}\mathcal{H}(\mathfrak{t}) - (\varrho + \Lambda)\dot{E}^{-1}\mathcal{U}(\mathfrak{t}) \\ \mathcal{G}(\mathfrak{t}) &= \mathcal{G}_0 + \Omega\varpi\dot{E}^{-1}\mathcal{H}(\mathfrak{t}) - (\varsigma + \Lambda)\dot{E}^{-1}\mathcal{G}(\mathfrak{t}) \\ \mathcal{C}(\mathfrak{t}) &= \mathcal{C}_0 + \varrho\dot{E}^{-1}\mathcal{U}(\mathfrak{t}) + \varsigma\dot{E}^{-1}\mathcal{G}(\mathfrak{t}) - \Lambda\dot{E}^{-1}\mathcal{C}(\mathfrak{t}) \\ \mathcal{W}(\mathfrak{t}) &= \mathcal{W}_0 + \mathfrak{k}\dot{E}^{-1}\mathcal{U}(\mathfrak{t}) + \mathfrak{y}\dot{E}^{-1}\mathcal{G}(\mathfrak{t}) - \xi\dot{E}^{-1}\mathcal{W}(\mathfrak{t})\end{aligned}\quad (3)$$

Using decomposition $J(\mathfrak{t}) = \sum_{n=0}^{\infty} J_n$

$$\sum_{n=0}^{\infty} J_n = J_0 + \mathfrak{c} - \Lambda\dot{E}^{-1}\left(\sum_{n=0}^{\infty} J_n\right) - \dot{E}^{-1}\left[\frac{\mathfrak{d}}{\mathcal{N}}(J\mathcal{U} + \mathfrak{B}J\mathcal{G}) + \ddot{Y}J\mathcal{W}\right] \quad (i)$$

Now, $J\mathcal{U}$, $J\mathcal{G}$ and $J\mathcal{W}$ can be expressed as:

$$\begin{aligned}J\mathcal{U} &= \sum_{n=0}^{\infty} \mathcal{Y}_n \\ J\mathcal{G} &= \sum_{n=0}^{\infty} \mathcal{X}_n \\ J\mathcal{W} &= \sum_{n=0}^{\infty} \mathcal{Z}_n \cdot \mathcal{X}_n\end{aligned}$$

$$\begin{aligned} y_n &= \sum_{r=0}^n J_r \sum_{r=0}^n u_r - \sum_{r=0}^{n-1} J_r \sum_{r=0}^{n-1} u_r \\ x_n &= \sum_{r=0}^n J_r \sum_{r=0}^n g_r - \sum_{r=0}^{n-1} J_r \sum_{r=0}^{n-1} g_r \\ z_n &= \sum_{r=0}^n J_r \sum_{r=0}^n w_r - \sum_{r=0}^{n-1} J_r \sum_{r=0}^{n-1} w_r \end{aligned}$$

Using these notations, the equation (i) can be written as:

$$J_{n+1}(t) = J_n(0) + c - \Lambda \dot{E}^{-1} J_n(t) - \dot{E}^{-1} \left[\frac{\dot{\Delta}}{\mathcal{N}} \left\{ \left(\sum_{n=0}^{\infty} y_n \right) + \mathbb{B} \left(\sum_{n=0}^{\infty} x_n \right) \right\} + \ddot{Y} \left(\sum_{n=0}^{\infty} z_n \right) \right] \quad (4)$$

Solving the remaining five equations of the differential Eq. (1) yields the following solutions:

$$\begin{aligned} \mathcal{H}_{n+1}(t) &= \mathcal{H}_n(0) + \dot{E}^{-1} \left[\frac{\dot{\Delta}}{\mathcal{N}} \left\{ \left(\sum_{n=0}^{\infty} y_n \right) + \mathbb{B} \left(\sum_{n=0}^{\infty} x_n \right) \right\} + \ddot{Y} \left(\sum_{n=0}^{\infty} z_n \right) \right] \\ &\quad - [(1 - \Omega)\varphi + \Omega\varpi + \Lambda] \dot{E}^{-1} \mathcal{H}_n(t) \\ \mathcal{U}_{n+1}(t) &= \mathcal{U}_n(0) + (1 - \Omega)\varphi \dot{E}^{-1} \mathcal{H}_n(t) - (\varrho + \Lambda) \dot{E}^{-1} \mathcal{U}_n(t) \\ \mathcal{G}_{n+1}(t) &= \mathcal{G}_n(0) + \Omega\varpi \dot{E}^{-1} \mathcal{H}_n(t) - (\varsigma + \Lambda) \dot{E}^{-1} \mathcal{G}_n(t) \\ \mathcal{C}_{n+1}(t) &= \mathcal{C}_n(0) + \varrho \dot{E}^{-1} \mathcal{U}_n(t) - \sigma \varsigma^{-1} \mathcal{G}_n(t) - \Lambda \dot{E}^{-1} \mathcal{C}_n(t) \\ \mathcal{W}_{n+1}(t) &= \mathcal{W}_n(0) + \mathfrak{K} \dot{E}^{-1} \mathcal{U}_n(t) - \mathfrak{Y} \dot{E}^{-1} \mathcal{G}_n(t) - \xi \dot{E}^{-1} \mathcal{W}_n(t) \end{aligned} \quad (5)$$

Eq. (4) and (5) are recurrence solutions for given mathematical model of the system of equations.

We investigated approximating iterative values with parametric values from Table 1. According to the World Health Organization (WHO) [23], 35% of India's population lives in cities or urban regions [24]. Therefore, we used a parameter ($\mathcal{N} = 481747192$) that represents 35% of the overall population. Thus, the stated equation may be expressed as:

$$\begin{aligned} \mathcal{N} &= J(0) + \mathcal{H}(0) + \mathcal{U}(0) + \mathcal{G}(0) + \mathcal{C}(0) + \mathcal{W}(0) \\ J(0) &= 480021700 \\ \mathcal{H}(0) &= 1724266 \\ \mathcal{U}(0) &= 745 \\ \mathcal{G}(0) &= 413 \\ \mathcal{C}(0) &= 66 \\ \mathcal{W}(0) &= 1000000 \end{aligned}$$

Based on the specifics shown in the inputs of the system of equation (3):

$$J(t) = J_0 + c - \Lambda \dot{E}^{-1} J(t) - \dot{E}^{-1} \left[\frac{\alpha}{\mathcal{N}} (J\mathcal{U} + \mathbb{B}J\mathcal{G}) + \ddot{Y}J\mathcal{W} \right]$$

$$\begin{aligned}\mathcal{H}(\mathfrak{t}) &= \mathcal{H}_0 + \dot{E}^{-1} \left[\frac{\ddot{\Delta}(\mathcal{J}\mathcal{U} + \mathcal{B}\mathcal{J}\mathcal{G})}{\mathcal{N}} + \ddot{\Upsilon}\mathcal{J}\mathcal{W} \right] - [(1 - \Omega)\varphi + \Omega\varpi + \Lambda]\dot{E}^{-1}\mathcal{H}(\mathfrak{t}) \\ \mathcal{U}(\mathfrak{t}) &= \mathcal{U}_0 + (1 - \Omega)\varphi\dot{E}^{-1}\mathcal{H}(\mathfrak{t}) - (\varrho + \Lambda)\dot{E}^{-1}\mathcal{U}(\mathfrak{t}) \\ \mathcal{G}(\mathfrak{t}) &= \mathcal{G}_0 + \Omega\varpi\dot{E}^{-1}\mathcal{H}(\mathfrak{t}) - (\varsigma + \Lambda)\dot{E}^{-1}\mathcal{G}(\mathfrak{t}) \\ \mathcal{C}(\mathfrak{t}) &= \mathcal{C}_0 + \varrho\dot{E}^{-1}\mathcal{U}(\mathfrak{t}) + \varsigma\dot{E}^{-1}\mathcal{G}(\mathfrak{t}) - \Lambda\dot{E}^{-1}\mathcal{C}(\mathfrak{t}) \\ \mathcal{W}(\mathfrak{t}) &= \mathcal{W}_0 + \mathfrak{k}\dot{E}^{-1}\mathcal{U}(\mathfrak{t}) + \mathfrak{y}\dot{E}^{-1}\mathcal{G}(\mathfrak{t}) - \xi\dot{E}^{-1}\mathcal{W}(\mathfrak{t})\end{aligned}$$

The complete solution is provided by the series given below:

$$\begin{aligned}\mathcal{J}(\mathfrak{t}) &= \mathcal{J}_0 + \mathcal{J}_1 + \mathcal{J}_2 + \mathcal{J}_3 \dots \\ \mathcal{H}(\mathfrak{t}) &= \mathcal{H}_0 + \mathcal{H}_1 + \mathcal{H}_2 + \mathcal{H}_3 \dots \\ \mathcal{U}(\mathfrak{t}) &= \mathcal{U}_0 + \mathcal{U}_1 + \mathcal{U}_2 + \mathcal{U}_3 \dots \\ \mathcal{G}(\mathfrak{t}) &= \mathcal{G}_0 + \mathcal{G}_1 + \mathcal{G}_2 + \mathcal{G}_3 \dots \\ \mathcal{C}(\mathfrak{t}) &= \mathcal{C}_0 + \mathcal{C}_1 + \mathcal{C}_2 + \mathcal{C}_3 \dots \\ \mathcal{W}(\mathfrak{t}) &= \mathcal{W}_0 + \mathcal{W}_1 + \mathcal{W}_2 + \mathcal{W}_3 \dots\end{aligned}\tag{6}$$

Simultaneously solving distinct partitions yields these solution systems (taking $\mathfrak{v}^2 = \mathfrak{t}$).

The values of the system with $\mathfrak{t} = 0$ are as follows:

$$\begin{aligned}\mathcal{J}_0 &= 480021700 \\ \mathcal{H}_0 &= 1724266 \\ \mathcal{U}_0 &= 745 \\ \mathcal{G}_0 &= 413 \\ \mathcal{C}_0 &= 66 \\ \mathcal{W}_0 &= 1000000\end{aligned}\tag{7}$$

$$\text{Now, } \mathcal{J}_1 = \mathfrak{ct} - \Lambda\mathcal{J}_0\mathfrak{t} - \dot{E}^{-1} \left[\frac{\ddot{\Delta}}{\mathcal{N}} (\mathcal{J}_0\mathcal{U}_0 + \mathcal{B}\mathcal{J}_0\mathcal{G}_0) + \ddot{\Upsilon}\mathcal{J}_0\mathcal{W}_0 \right]$$

By putting the value, we get, $\mathcal{J}_1 = 6931614\mathfrak{t} - (0.014)(480021700)\mathfrak{t} - 5.18 \times 10^{-10}[480021700 \times 745 + 0.59 \times 480021700 \times 413] + 0.123 \times 10^{-7}(480021700)(1000000)$

$$\mathcal{H}_1 = [5.18 \times 10^{-10}(474583054139 + 5870907.63)]\mathfrak{t}$$

$$\mathcal{U}_1 = [0.0043(1724266) - 0.1127(745)]\mathfrak{t}$$

$$\mathcal{G}_1 = [0.00062(1724266) - 0.8683(413)]\mathfrak{t}$$

$$\mathcal{C}_1 = [0.09871(745) + 0.8543(413) - 0.014(66)]\mathfrak{t}$$

$$\mathcal{W}_1 = -9999.29\mathfrak{t}\tag{8}$$

These are the initial set of solutions for all equations with $\mathfrak{t} = \mathfrak{t}^1$.

Using the provided data, the simultaneous solution set for $\mathfrak{t} = \mathfrak{t}^2$ may be obtained.

$$\begin{aligned} \mathcal{J}_2 &= -\mathcal{J}_1[0.014 + 43956.44 \times 10^{-10} - 1229.91 \times 10^{-7}] \frac{\mathfrak{t}^2}{3} \\ \mathcal{H}_2 &= [\mathcal{J}_1\{43956.44 \times 10^{-10} - 1229.91 \times 10^{-7}\} - (0.019347)\mathcal{H}_1] \frac{\mathfrak{t}^2}{2} \\ \mathcal{U}_2 &= [(0.004727)\mathcal{H}_1 - (0.1127)\mathcal{U}_1] \frac{\mathfrak{t}^2}{2} \\ \mathcal{G}_2 &= [(0.00062)\mathcal{H}_1 - (0.8683)\mathcal{G}_1] \frac{\mathfrak{t}^2}{2} \\ \mathcal{C}_2 &= [(0.09871)\mathcal{U}_1 + (0.8543)\mathcal{G}_1 - (0.014)\mathcal{C}_1] \frac{\mathfrak{t}^2}{2} \\ \mathcal{W}_2 &= [(0.000398)\mathcal{U}_1 + (0.0001)\mathcal{G}_1 - (0.01)\mathcal{W}_1] \frac{\mathfrak{t}^2}{2} \end{aligned} \quad (9)$$

And solution for $\mathfrak{t} = \mathfrak{t}^3$ can be given by:

$$\begin{aligned} \mathcal{J}_3 &= -\mathcal{J}_2[0.014 + 5.18 \times 10^{-10}\{\mathcal{U}_2 + (0.5944)\mathcal{G}_2\} + 0.123 \times 10^{-7}\mathcal{W}_2] \frac{\mathfrak{t}^3}{6} \\ \mathcal{H}_3 &= [\mathcal{J}_2\{5.18 \times 10^{-10}(\mathcal{U}_2 + (0.5944)\mathcal{G}_2 + 0.123 \times 10^{-7}\mathcal{W}_2) - (0.019347)\mathcal{H}_2\}] \frac{\mathfrak{t}^3}{6} \\ \mathcal{U}_3 &= [(0.004727)\mathcal{H}_2 - (0.1127)\mathcal{U}_2] \frac{\mathfrak{t}^3}{6} \\ \mathcal{G}_3 &= [(0.00062)\mathcal{H}_2 - (0.8683)\mathcal{G}_2] \frac{\mathfrak{t}^3}{6} \\ \mathcal{C}_3 &= [(0.09871)\mathcal{U}_2 + (0.8543)\mathcal{G}_2 - (0.014)\mathcal{C}_2] \frac{\mathfrak{t}^3}{6} \\ \mathcal{W}_3 &= [(0.000398)\mathcal{U}_2 + (0.001)\mathcal{G}_2 - (0.01)\mathcal{W}_2] \frac{\mathfrak{t}^3}{6} \end{aligned} \quad (10)$$

Putting values from Eq. (7), (8), (9), and (10) in the system of equations (6),

$$\mathcal{J}(\mathfrak{t}) = \mathcal{J}_0 + \mathcal{J}_1 + \mathcal{J}_2 + \mathcal{J}_3 \dots$$

$$\mathcal{H}(\mathfrak{t}) = \mathcal{H}_0 + \mathcal{H}_1 + \mathcal{H}_2 + \mathcal{H}_3 \dots$$

$$\mathcal{U}(\mathfrak{t}) = \mathcal{U}_0 + \mathcal{U}_1 + \mathcal{U}_2 + \mathcal{U}_3 \dots$$

$$\mathcal{G}(\mathfrak{t}) = \mathcal{G}_0 + \mathcal{G}_1 + \mathcal{G}_2 + \mathcal{G}_3 \dots$$

$$\mathcal{C}(t) = \mathcal{C}_0 + \mathcal{C}_1 + \mathcal{C}_2 + \mathcal{C}_3 \dots$$

$$\mathcal{W}(t) = \mathcal{W}_0 + \mathcal{W}_1 + \mathcal{W}_2 + \mathcal{W}_3 \dots$$

Conclusively we get, $\mathcal{J}(t) = (480021700) - (5693202.83517)t + (39514.82584)t^2 - (62563184.50875)t^3 + \dots$

$$\mathcal{H}(t) = (1724266) + (5871153.461256)t - (56457.0089)t^2 + (548.5999)t^3 + \dots$$

$$\mathcal{U}(t) = 745 + (8066.64213)t + (13421.911)t^2 - (593.1738)t^3 + \dots$$

$$\mathcal{G}(t) = 413 + (710.4421)t + (1511.621)t^2 - (449.1832)t^3 + \dots$$

$$\mathcal{C}(t) = 66 + (425.44325)t + (698.6157)t^2 + (868.8243)t^3 + \dots$$

$$\mathcal{W}(t) = 1000000 - (9999.2911)t + (51.95567)t^2 + (2.111346)t^3 + \dots \quad (11)$$

4. RESULTS AND INTERPRETATIONS

Our findings indicate that with effective social distancing measures, COVID-19 may be controlled after 25-30 days of rigorous lockout (Fig. I). According to Fig. II, the number of exposed persons is projected to gradually grow over 4 months after illness onset. It is worth noting that this graph (Fig. III) is also dependent on the number of newly infected individuals. After 150 days (about 5 months), there was a significant rise in the number of exposed people, which had previously been insignificant up to the first 50 days. Even if the illness epidemic had 50 crore suspects within 4-5 months.

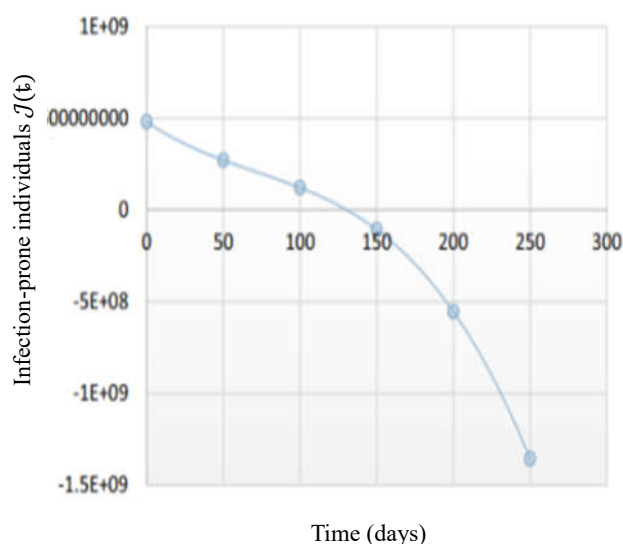


Fig. I

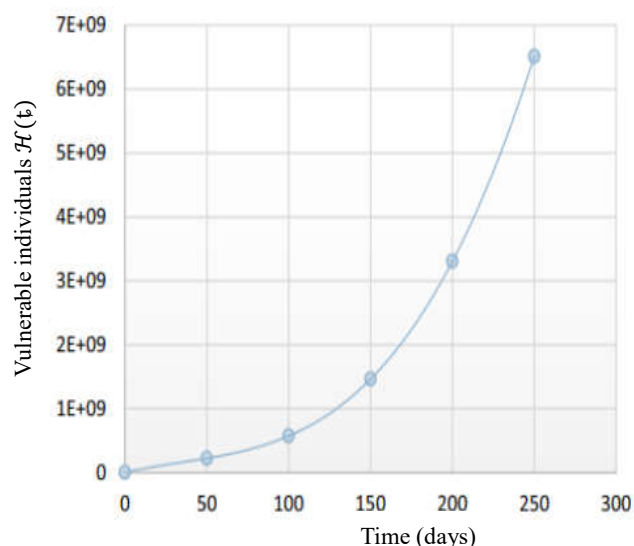


Fig. II

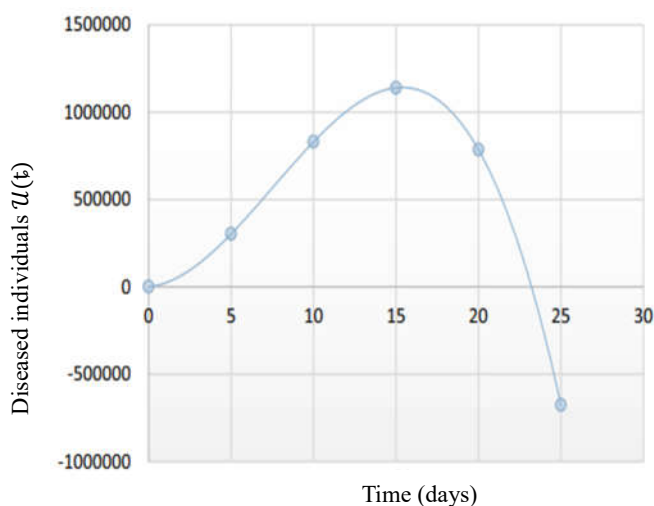


Fig. III

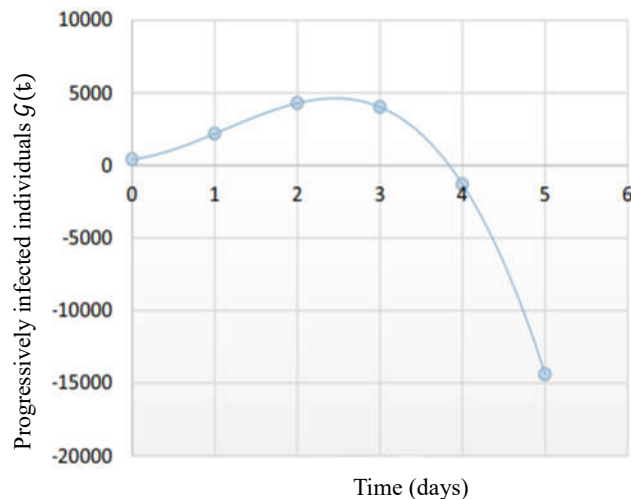


Fig. IV

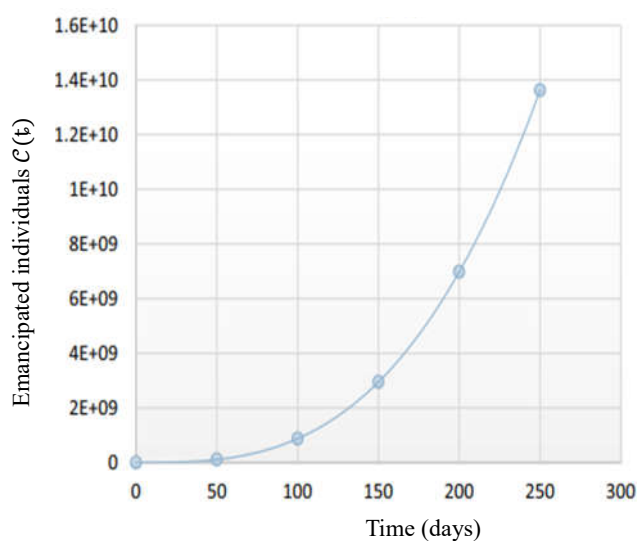


Fig. V

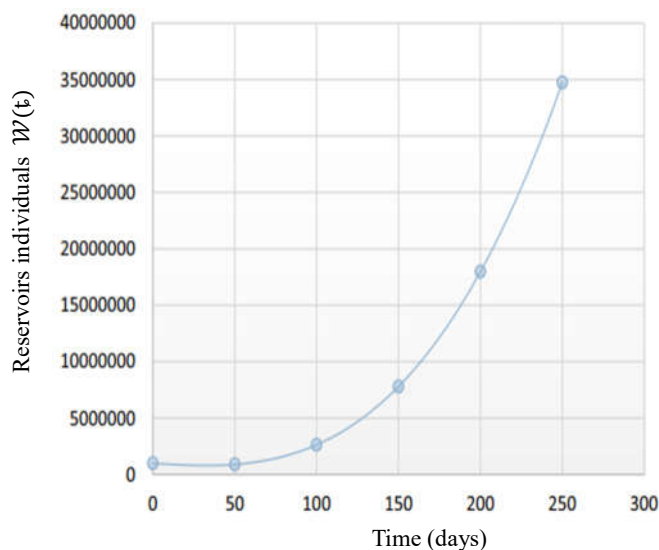


Fig. VI

Figure 1: Analyzing the Adomian decomposition approach to assess the COVID-19 epidemiology in the Indian population.

(Fig. I) Chronoscopic demeanor of infection-prone individuals ($J(t)$), (Fig. II) Chronoscopic demeanor of vulnerable individuals ($\mathcal{H}(t)$), (Fig. III) Chronoscopic demeanor of diseased individuals ($U(t)$), (Fig. IV) Chronoscopic demeanor of progressively infected individuals ($G(t)$), (Fig. V) Chronoscopic demeanor of emancipated individuals ($C(t)$), (Fig. VI) Chronoscopic demeanor of reservoir individuals ($W(t)$).

Numbers can still be lowered to zero (Fig. IV). Fig. V shows that steady disease management might have been accomplished with appropriate and effective social distance, as evidenced by the consistent number of suspected recovered persons.

Our mathematical model's parameters can inform future pandemic control methods. Consider other considerations, such as gender stratification, age-related death risk, epidemiological characteristics, and smoking habit, when considering constraints.

5. CONCLUSIONS

This study aimed to determine the final numerical reality (month-by-month) of social distancing during the lockdown period, as well as the expected reduction in COVID-19 cases when the situation is under control. The discussion of clinical progression timelines, including pathogen entrance, life cycle, and recovery, can aid in epidemic analysis and control (Fig. II). In its early beginnings, the pathogen adheres to the cell surface after 5 minutes of infection and takes over the cell's function within 30 minutes. The virus attacks lung cells and reaches its peak stage in 10-13 days. At this point, the body's immune cells react and generate cytokines to eradicate the virus. The virus has an average incubation time of 5.1 days and patients typically recover after 2-3 weeks of infection. As a result, these models are quite useful for predicting. To effectively treat and manage COVID-19, healthcare facilities must have critical/intensive care units, ventilators, protective kits, and medications. Using the Adomian decomposition approach on the Indian population impacted by COVID-19, we can demonstrate that tight initial isolation for 22-25 days has a considerable favorable influence on the overall pandemic scenario. Finally, the given mathematical model will take into account any further actions or activities that our government may need to do to reduce the illness burden.

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